

50.12
41a
8

Experiment Station
Circular No. C-128
March 1948

Oklahoma Agricultural
Experiment Station

Chemical Control of Weeds In Oklahoma for 1948

By
W. C. ELDER
and
F. A. ROMSHE



OKLAHOMA AGRICULTURAL EXPERIMENT STATION

Oklahoma A. and M. College, Stillwater

W. L. Blizzard, *Director*

Louis E. Hawkins, *Vice Director*

CONTENTS

WEEDS IN FIELD CROPS

2,4-D (Dichlorophenoxyacetic Acid) -----	5
Conditions Affecting Results of 2,4-D Treatments -----	5
2,4-D Formulations -----	6
Methods of Application -----	7
Use With Specific Crops -----	7
Winter Wheat -----	7
Spring Oats and Barley -----	8
Corn and Sorghums -----	8
Pastures -----	8
Use on Lawns -----	8
Bindweed Control With 2,4-D -----	8
Precautions in Using 2,4-D -----	9
Sodium Chlorate and Atlacide -----	10
Borax -----	10
Ammonium Sulfate (Ammate) -----	10

WEEDS IN HORTICULTURAL CROPS

General Information -----	11
Stoddard Solvent -----	11
Pre-emergence Treatments -----	11
Use of Chemicals With Specific Crops -----	12
Asparagus -----	12
Carrots and Related Plants -----	12
Lawns -----	8
Onions -----	12
Peas (commercial) -----	13
Potatoes (Irish) -----	13
Sweet Corn -----	13
Strawberries -----	13

APPENDIX: Weeds Classified by Effect of 2,4-D; and Recommended Spray Rates -----	14
---	----

CHEMICAL CONTROL OF WEEDS IN OKLAHOMA FOR 1948.

Chemicals for weed control have developed rapidly in recent years. They can now be used as effective aids to older methods of controlling weeds by cultivation. This circular brings together the available information on use of chemicals for controlling the weeds common in Oklahoma.

It should be understood that the recommendations made in this circular are only tentative. Each year will add new information, and probably bring revisions of former recommendations, as research men learn more about the action of weed-controlling chemicals and farmers gain more experience in using them.

WEEDS IN FIELD CROPS

By W. C. ELDER
Assistant Agronomist

Experiments in control of field weeds with different chemicals have been conducted at the Oklahoma Agricultural Experiment Station for the past two years. On the basis of results to date, the following tentative statements and recommendations can be made for use in Oklahoma in 1948.

2,4-D (DICHLOROPHENOXYACETIC ACID)

2,4-D has had much publicity in its short life. A very large acreage of growing crops will be treated with 2,4-D to kill weeds in 1948 in certain areas of the United States. Unfortunately, this chemical will not solve some of the major weed problems in Oklahoma.

2,4-D has many advantages. It is non-poisonous to man and animal, and is economical to use. It is non-inflammable and does not corrode equipment. The remarkable selectivity of 2,4-D is valuable because many weeds can be killed in growing crops.

2,4-D in various forms is sold under a large number of trade names. The bottle or other container will usually tell the form of 2,4-D and the uses for which it is intended.

CONDITIONS AFFECTING RESULTS OF 2,4-D TREATMENTS.

Several factors must be considered before 2,4-D is used. First, weeds must be growing actively to obtain maximum results. Weeds are more easily killed when moisture and fertility conditions are

just right for plant growth. 2,4-D is not as effective during dry weather when plants are somewhat dormant.

Another factor is stage of plant growth. Annual weeds should be sprayed when young or in the seedling stage. Double the usual amount of 2,4-D is necessary to kill many annuals after they are near the blooming stage. Perennial weeds, as a general rule, are most susceptible when in the bud stage or just before blooming.

Applications can be made under a wide range of temperatures. Temperature under 70° F. will reduce the speed of the chemical's action, but not the killing effect. It is not advisable to use 2,4-D when temperatures are extremely high.

Some weeds are very susceptible to 2,4-D and can be eradicated with minimum dosage. This group includes pigweed, sunflowers, mustards, and cocklebur. Other weeds such as smartweed, wild buckwheat, knotweeds and prickly lettuce are tolerant, and maximum dosage is necessary for control. One must know the reaction of each species to 2,4-D before efficient applications can be made.

A tentative grouping of the more common Oklahoma weeds according to their reaction to 2,4-D, and dosages for each group, are given on pages 14 and 15.

2,4-D FORMULATIONS.

Pure 2,4-D is not soluble in water, so it is mixed in many different ways to make it usable. Most of the 2,4-D preparations commonly used in weed control fall into one of three types:

1. Sodium and ammonium salts as powder.
2. Esters in the liquid form.
3. Amine salts.

Most of these preparations are made to be mixed with water and applied as a spray. Some are prepared for application in dust form.

When purchasing 2,4-D, look for the acid content on the container. The formulations are manufactured in concentrations of 10% to 80% acid content. The cost will depend on the concentration; and rates of application must be based on the percentage of acid in the particular mixture being used. (Further information on rates of application is given on page 14.)

It is difficult to decide which of the different types of 2,4-D preparations is best, because of the many factors involved. On the basis of equivalent weights of acid, the ester types are more effective than the salt types on resistant weeds and when conditions are not best for effective application. For most weeds, the rate of ap-

plication (acid basis) per acre with esters can be about half of that needed when the salt types are used. However, the esters will injure crops more easily than the salt type when maximum dosages are applied. The esters are oily and therefore best to use when 2,4-D is applied under very dry conditions or just before rains. The amines are intermediate between the esters and the salts.

METHODS OF APPLICATION.

2,4-D is usually applied as a spray. It may also be used as a dust; but dusting is not recommended for Oklahoma because of the dry weather and danger of drifting by wind.

Sprays for weeds should be applied at pressures of 20 to 50 pounds per square inch. Nozzles that produce a fan-shaped spray are preferred.

In the past, 2,4-D has been sprayed at rates of 150 to 200 gallons of water per acre. Much lower volumes per acre can now be used with just as effective results. Equipment is now available for applying at rates as low as 5 to 10 gallons per acre. Even lower rates are used when 2,4-D is mixed with diesel oil.

For lawns, fence lines and small areas, the knapsack sprayer is satisfactory. For field work, a spray boom can be placed at the front of a tractor and the spray carried in barrels on the side or rear of the tractor. The boom is made by placing nozzles 18 to 24 inches apart on a long pipe. When spraying, it is set at a height of 18 to 24 inches above the weeds. Almost any spray pump can be adapted to weed work. Where very large areas of weeds are treated, many farmers are using small pumps driven by the power takeoff of the tractor.

USE WITH SPECIFIC CROPS.

Winter Wheat.—2,4-D can be used profitably on winter wheat only under two conditions:

- (1) When weed infestation is heavy enough to warrant taking some loss in yield of wheat, or

- (2) When stand is so thin or late in maturing that it may allow weeds to develop enough to interfere with combining.

Most weeds susceptible to 2,4-D can be controlled in growing wheat by applying one-half pound ester or one pound salt or amine per acre (acid basis) when the wheat is tillered but not yet in the bloom stage. The high rates of 2,4-D needed to kill resistant weeds will affect yields of the wheat. (Use of 2,4-D to kill bindweed in wheat is discussed on pages 8 and 9.)

Light applications in the fall will damage the wheat considerably.

Spring Oats and Barley.—Spring oats and barley should be treated after stooling but not in the bloom stage. Minimum applications of one-half pound ester or one pound salt or amine per acre (acid basis) may lower yields slightly.

Corn and Sorghum.—2,4-D can be used to best advantage on corn and sorghums when cultivation is impossible because of wet soils, or when susceptible weeds escape cultivation in the row. The chemical can be used to keep down weeds after last cultivation by directing the spray on the lower parts of the corn or sorghum stalks. It possibly might be used to replace the last cultivation by proper application. One-half pound ester or one pound salt or amine of 2,4-D per acre (acid basis) can be used on corn and sorghums with minimum injury. Heavy dosages may cause severe lodging. Some varieties may be more susceptible than others.

Pastures.—Most established pasture grasses can be treated with a sufficient amount of 2,4-D to control most susceptible weeds. *This chemical cannot be used in clover pastures*, and a very small amount may affect young grass seedlings. Perennial ragweeds are troublesome in many Oklahoma pastures and cannot be controlled effectively with the mower. One-half pound ester or one pound salt or amine of 2,4-D per acre (acid basis) will eradicate this pest.

USE ON LAWNS.

2,4-D quickly establishes itself as by far the best herbicide for grass lawns. However, bent grasses and clovers are killed by 2,4-D, therefore it cannot be used on lawns which include these plants. Buffalo grass may be injured under some conditions. Bermuda grass is very resistant to 2,4-D.

Late October or early November is the best time to kill dandelions in Oklahoma with 2,4-D. This lawn pest may also be treated with fair success in March just before full bloom. Very poor results are received from late spring and summer application.

Chickweed and henbit are not easily killed by 2,4-D (see page 14.)

BINDWEED CONTROL WITH 2,4-D.

The major weed problem in Oklahoma now is the field bindweed. Most of this infestation is on wheat land. 2,4-D will help control and assist in the eradication of this field pest, but bindweed cannot be eradicated by the first application of 2,4-D. Treatments

will destroy the vegetation above ground, but new plants will arise from the extensive root system.

When applied at the proper time, 2,4-D will kill a large percentage of the bindweeds. In experiments at Stillwater, best results have been obtained from fall applications, made after rains when the vines were growing rapidly. Another good time to spray this weed is in May just before it starts blooming. Very poor results are obtained from summer applications when it is dry and hot.

Where it is desirable to grow wheat continuously, 2,4-D usually will have to be used in the growing wheat, either in the fall or spring, to be effective. When wheat is sprayed in the seedling stage or in the fall, reduced yields can be expected.

It is impossible to use large spray equipment on wheat in the spring months if the weed is treated at the proper stage of growth. Much of the standing wheat would be broken down. Small hand equipment could be used on small areas in the spring.

When moisture conditions are favorable for seedbed preparation in early September it is possible to delay planting until after treatment of the bindweed. Under this system the seedbed would be prepared in early September and the bindweed allowed to grow until the middle of October, then treated. Wheat planting would have to be delayed 20 to 30 days after spraying the weeds—that is, until November 5 to 15. This is past the best date of planting for wheat in Oklahoma, but the delay may be necessary to get control of the bindweed.

After spraying either in the fall or spring, it is very necessary to cultivate intensively the following summer between harvest and seeding time. The clean cultivation will help eradicate plants that recover from 2,4-D treatments.

It is easier to use 2,4-D for bindweed in spring oats than in wheat. Fall applications can be made at the most desirable time (about October 15) after the preceding crop has been removed. Or bindweeds can be treated in oats planted during the spring months. (See page 8.)

PRECAUTIONS IN USING 2,4-D.

1. Crops should not be planted in soil that has been treated recently with 2,4-D. However, it remains in the soil only for a short time. Resistant crops such as wheat or corn can be planted 30 days after soil treatment. Susceptible crops such as cotton and clovers should not be planted for 60 days.

2. Spray equipment must be washed out thoroughly before using other sprays on crops that are susceptible to 2,4-D.

3. Care must be taken to prevent drift when spraying around gardens, shrubs, flowers or crops that are easily killed with 2,4-D.

4. Pasture crops and lawns that have clovers growing in them should not be treated. 2,4-D will kill or severely injure all clovers and other legumes.

5. The manufacturer's instructions must be followed carefully. All ingredients should be accurately weighed or measured.

SODIUM CHLORATE AND "ATLACIDE"

Sodium chlorate can be recommended for use on small areas of deep rooted, persistent weeds. It can be applied either as a dust or a spray. For spraying, "Atlacide" (a form of sodium chlorate) is usually used because it is less inflammable.

Sodium chlorate can be used in Oklahoma on small spots of bindweed, Bermuda and Johnson grasses. Best results are obtained by using 4 pounds of dry powder per square rod, applied in October or November. It can also be applied as a spray on the growing vegetation.

Sodium chlorate is very good to use in fence rows to prevent the spread of noxious weeds. When applied properly it will kill all vegetation on the treated area for two years or more. It is expensive, therefore it can be used only on small areas.

BORAX

Borax is recommended for killing vegetation on non-agricultural lands, such as areas bordering petroleum installations, warehouses or other places where vegetation constitutes a fire hazard. Borax is toxic to the soil for several years. Use 25 pounds or more per square rod, or 20 pounds borax and 2 pounds sodium chlorate per square rod.

AMMONIUM SULFAMATE ("AMMATE")

Ammonium sulfamate (sold under the trade name "Ammate") can be used as a foliage spray (one pound per gallon) on woody shrubs. It is very good for poison ivy, but in the past has been too expensive to use on large areas.

Ammate is inefficient on perennial weeds or grasses because it does not kill the permanent root system.

WEEDS IN HORTICULTURAL CROPS

By **F. A. ROMSHE**

Associate Horticulturist, Vegetables

The limited extent of experimental work on the use of chemicals for weed control in vegetables and fruits, and the conflicting results secured, make general recommendations questionable. The directions listed here are offered only as suggestions. They are based on reports of various research workers in the North Central states.

GENERAL INFORMATION

Anyone planning to use 2,4-D should be familiar with the information given on pages 5 to 7, and the precautions listed on pages 9 and 10. Susceptibility of various weeds to 2,4-D is listed in the Appendix, page 14.

STODDARD SOLVENT.

Stoddard solvent is a paraffin base petroleum dry-cleaning fluid. It is sold under various trade names by different manufacturers. Gasoline stations or wholesale oil distributors are the most likely sources of supply.

This material kills most annual plants rapidly upon contact if used when the plants are small. Repeat treatments are necessary for complete killing of large weeds.

Stoddard solvent is volatile and little or no residue remains in the soil. It is more expensive than most other weed killers and its chief use is for weed control in carrots and related crops, which are not appreciably affected by it if used properly.

PRE-EMERGENCE TREATMENTS.

The use of chemicals to kill weeds that germinate after a crop has been planted and before the crop plants come up appears to be the most promising method for general use on vegetables. Such a treatment would, of course, be most effective for crops that require a week or more to come up after being planted. The first crop of weeds will have emerged and can be destroyed without disturbing the soil, thus avoiding bringing additional weed seed to the surface.

2,4-D at the rate of one pound ester or two pounds salt or amine per acre (acid equivalent) can be used. Best results are secured if the soil is moist at the time of application.

Stoddard solvent applied at a rate of 80 to 100 gallons per acre is also effective to control weeds and grasses that have germinated.

USE OF CHEMICALS WITH SPECIFIC CROPS

ASPARAGUS.

Cyanamid dusted over asparagus rows just before cutting starts in the spring will usually control weeds during the cutting season. One hundred pounds per acre should be used.

2,4-D (sodium salt or ester formulations*) can be applied at the rate of $1\frac{1}{4}$ to $1\frac{1}{2}$ lbs. per acre (acid equivalent) during the cutting season to control most weeds. Crabgrass may or may not be affected. Very small grass seedlings are sensitive to 2,4-D, but after the plants become established (2 inches or more in height) this material has little effect on them. Any asparagus spears that are above ground at the time of spraying will be distorted. Subsequent growth will not be affected.

Stoddard solvent can be applied after the cutting season to control crab grass and other annual weeds in the row. Apply at the rate of 80 to 100 gallons per acre when the grass and weeds are two inches or less in height. Avoid as much as possible getting the spray on the growing tips of asparagus.

CARROTS AND RELATED PLANTS.

Stoddard solvent sprayed directly over the row at the rate of 50 to 60 gallons per acre controls weeds and grasses in carrots and related plants.** The first application should be made when the vegetable plants have developed two or more true leaves. Eighty to 100 gallons per acre should be used for over-all spraying. This material will impart an oily flavor to carrots if applied after the roots are $\frac{1}{2}$ inch in diameter or larger.

LAWNS.

See page 8.

ONIONS.

A 2% solution (by volume) of sulfuric acid, at a rate of 100 to 150 gallons per acre, is recommended for control of small broad-leaved weeds in onions. Applications can be made when the onion seedlings have one true leaf, or at any time later. Spraying equipment that is acid-resistant is required for use with sulfuric acid.

Concentrated salt solution is effective against most weeds when used at a rate of 100 gallons per acre and applied when the onion plants are developing the second true leaf. The onion plants may wilt down from the treatment but will recover.

* See page 6.

** Parsley, parsnips, caraway, and dill.

PEAS (COMMERCIAL) .

Peas being grown for commercial canning can be treated with ammonium salts of the dinitro compounds. Apply according to the manufacturer's directions.

POTATOES (IRISH) .

Stoddard solvent or 2,4-D can be used as a pre-emergence spray to kill weeds on the ridge over the row. The spraying must be done before the potato sprouts emerge.

SWEET CORN.

2,4-D can be applied as a pre-emergence spray to control most broadleaved annual weeds in sweet corn. One pound of ester or 2 pounds salt or amine per acre (acid basis) should be used.

STRAWBERRIES.

There is some evidence that most strawberry varieties are fairly resistant to 2,4-D. It can be used throughout the growing season the first year plants are set, but on older beds it should be used only after the harvest season. Injury may result if an application is made to blooming or fruiting plants. Some distortion of leaves and runners will be seen, but the plants will recover and continue normal growth. The sodium salt formulation should be used at the rate of one pound (acid equivalent) per acre.

APPENDIX

Weeds Classified by Effect of 2,4-D;
and Recommended Spray Rates

The following list shows the common weeds of Oklahoma arranged according to how easily they are killed by 2,4-D. Perennial weedy grasses are not listed. All such grasses are highly resistant to 2,4-D; therefore this chemical cannot be used to control them.

This listing also shows the amounts of 2,4-D to use on each class of weeds. *The amount to use per acre is based on 2,4-D acid content.* The minimum rate given is for esters, and the maximum rate given is for salt types.* It takes 1.4 pounds (1 lb., 6 1/2 oz.) of a powdered salt with an acid content of 70 percent to equal one pound per acre. About three pints of a 33 percent ester would equal one pound of acid, provided the ester was near the weight of water.

GROUP I—ANNUALS.

- (a) Annual weeds easily killed with 2,4-D when young. Use 1/2 lb. ester or 1 lb. salt or amine per acre (acid basis).

- | | |
|----------------------|-----------------------|
| 1. Bracted plantain | 9. Morning glory |
| 2. Carpetweed | 10. Peppergrass |
| 3. Cocklebur | 11. Pigweeds |
| 4. False flax | 12. Prostrate vervain |
| 5. Flower-of-an-hour | 13. Ragweeds |
| 6. Jimsonweed | 14. Sunflower |
| 7. Kochia | 15. Vetch |
| 8. Marsh elder | 16. Wild mustards |

- (b) Annual weeds that are not killed readily with 2,4-D. Use 3/4 lb. ester or 1 1/2 lb. salt or amine per acre (acid basis).

- | | |
|--------------------|---------------------|
| 1. Buckwheat, wild | 8. Maretail |
| 2. Chickweed | 9. Mat spurge |
| 3. Coreopsis | 10. Mayweed |
| 4. Henbit | 11. Purslane |
| 5. Knotweed | 12. Russian thistle |
| 6. Lamb's-quarters | 13. Smartweeds |
| 7. Mallow | 14. Wild lettuce |

* Information on the different types of 2,4-D is given on page 6.

(c) Annual weeds resistant to 2,4-D.

- | | |
|----------------|----------------|
| 1. Buffalo bur | 5. Foxtails |
| 2. Cheat | 6. Goose grass |
| 3. Corn cockle | 7. Sandburs |
| 4. Crabgrass | 8. Wood sorrel |

GROUP II—PERENNIALS.

(a) Perennial weeds usually killed with 2,4-D. Use 1 lb. ester or 2 lb. salt or amine per acre (acid basis).

- | | |
|------------------------|----------------------|
| 1. Dandelions | 6. Spurge nettle |
| 2. Four-O'clock | 7. Western ragweed |
| 3. Hedge bindweed | 8. Wild sweet potato |
| 4. Jerusalem artichoke | 9. Wormwood |
| 5. Plantains | |

(b) Perennial weeds, the eradication with 2,4-D is not certain but can be kept under control. Use 1 lb. ester or 2 lb. salt or amine per acre (acid basis).

- | | |
|----------------------|---------------------------|
| 1. Blueweed | 8. Field bindweed |
| 2. Bur ragweed | 9. Goldenrods |
| 3. Canada thistle | 10. Gourd, wild |
| 4. Carrot, wild | 11. Pokeweed |
| 5. Climbing milkweed | 12. Sorrell, red or sheep |
| 6. Docks | 13. Wild onion |
| 7. Dogbane | 14. Yarrow |

(c) Perennial weeds resistant to 2,4-D.

- | | |
|------------------|------------------|
| 1. Bermuda grass | 5. Johnson grass |
| 2. Cactus | 6. Milkweeds |
| 3. Ground cherry | 7. Ox-eye daisy |
| 4. Horse nettle | 8. Wood sorrel |

